

503.05. METHOD OF MEASUREMENT.

Prestressed concrete beams and double tees will be measured by the linear foot (meter), complete in place, as shown on the plans. Concrete and reinforcing steel placed in haunches in excess of the plan quantity will not be measured for payment.

Prestressed concrete piling will be measured as specified in Section 514. Prestressed concrete stay-in-place forms will not be measured for payment; Refer to Section 502.

Anchor plates, anchor bolt assemblies, and diaphragm bolt assemblies for prestressed concrete members will be measured as structural steel under Section 506. Embedded plates will not be measured for payment.

503.06. BASIS OF PAYMENT.

The accepted quantities, measured as specified in this Section, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the Plan bid schedule. Payment will be full compensation for the respective work prescribed in this Section.

- (A) PRESTRESSED CONCRETE BEAMS.LINEAR FOOT (METER)
- (B) PRESTRESSED CONCRETE DOUBLE TEESLINEAR FOOT (METER)

SECTION 504**BRIDGE DECKS, APPROACHES, RAILS AND PARAPETS****504.01. DESCRIPTION.**

This work consists of constructing concrete bridge decks and approach slabs according to these Specifications and in reasonably close conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

This work also consists of the construction of railings and parapets for bridges, roadways, wing walls, retaining walls, and other structures, in accordance with these Specifications and in reasonably close conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

Comply with the requirements of Section 414 for approach slabs, except as modified in this Section.

504.02. MATERIALS.

Use materials conforming to following Sections and Subsections.

Structural Concrete (<i>Class AA</i>)	509
Joint Fillers and Sealers	701.08
Reinforcing Steel for Structures	511
Curing Materials	701.07
Metal Beam Railing	732.01
Aluminum Alloy Tubes for Railings	732.03
Cast Aluminum Alloy Bridge Railing Posts	732.03
Pipe Railing	732.04

When using stay-in-place prestressed concrete deck forms, include an approved corrosion-inhibiting admixture in all cast-in-place bridge deck concrete and precast deck form concrete.

Limit the concrete temperature for bridge decks and approach slabs to a maximum of 85°F (30°C).

504.03. EQUIPMENT.

- (a) **Finishing Machine.** Use an approved self-propelled finishing machine to transversely finish the bridge deck and approach slabs. Before placing concrete, submit to the Engineer for approval, a description of the finishing machine, including make and model, a finishing plan, and a plan for equipment breakdown, listing spare equipment and parts, and estimated length of down time. Provide sufficient equipment and labor so that potential finishing machine down time is limited and concrete placement can be done within the time specified in Table 509-6 if a breakdown occurs.

Support the finishing machine on rails or steel-clad headers parallel to the centerline of the structure. Firmly fasten the rails and headers in place and set to correct line and grade with proper allowances for dead-load deflections. The rails, headers, and strike-off equipment shall be of sufficient strength and be adjusted so that the concrete surface after strike-off will conform to the planned profile and cross-section.

For bridge decks narrower than 30 feet (10m) wide, finishing templates or screeds may be used to longitudinally finish the bridge deck. Support the finishing template or screed on steel-clad header boards cut to the crown of the roadway. Use finishing templates or screeds of sufficient weight and rigidity (or trussed) to provide the specified longitudinal finish camber.

- (b) **Finned Float.** Unless saw-cut grooving is specified, use a finned float, having a single row of fins, to provide the final finish for the deck and approach concrete. The spacing of the fins shall correspond to the specified groove spacing. Do not use a tining rake, unless otherwise directed. If saw-cut grooving is specified, use a conventional float to finish the bridge deck and approach slabs.
- (c) **Fogging Equipment.** Provide a fogging system that will cover the entire area of fresh finished concrete. Provide a system that continuously keeps the air over this area cool and moist with a blanket of fog. Make fog using pressurized water and a series of fogging nozzles. Do not use common garden hose nozzles which can produce an excessive washing spray.

If the section of bridge deck or approach slab to be placed is less than 50 feet (15m) wide and less than 100 feet (30m) long, fogging may be made by mixing water and oil-free compressed air in a hand-held spray nozzle. Provide and use a minimum of two hand-held foggers with at least a third backup fogger. Use compressed air of sufficient pressure and flow to atomize the water into a fog.

Test the fogging equipment immediately before each placement to ensure the equipment is in good working order. Use approved fogging equipment only.

Other methods of controlling evaporation, such as, night placement, windbreaks, shades, or a combination of these may be used in lieu of fogging, if approved and proven effective.

- (d) **Grooving Machine.** If saw-cut grooving is specified or required, groove hardened concrete with a self-propelled grooving machine built for the purpose of grooving pavement or bridge decks. Use a grooving machine equipped with the following features:
- Diamond saw blades mounted on a multiblade arbor at the specified groove spacing.
 - A depth control device that detects variations in the surface of the bridge deck or pavement and adjusts the height of the cutting head to maintain the specified groove depth.
 - An alignment control device.
 - A vacuum attachment that removes and collects slurry or residue from grooving operation.
- (e) **Work Bridges.** Furnish at least two work bridges to enable workers to satisfactorily perform the floating, straightedging, fogging, curing and final finishing at the proper times.

504.04. CONSTRUCTION METHODS.

- (a) **Forming, Bracing, and Finishing Machine Rails.** See Subsections 502.02(b) and 502.04(b) for form requirements. Provide forms and bracing for the overhang part of the deck adequate to support the weight of the concrete, forms, finishing machine, and other construction loads. Brace exterior steel girders to prevent twisting or lateral displacement as specified in Subsection 502.04(a)9.

Set rails on non-yielding supports for the scheduled length of the concrete placement. Extend rails beyond both ends of the scheduled length of the concrete placement a sufficient distance that will permit the float of the finishing machine to fully clear the concrete to be placed. Use rails that are fully adjustable for elevation. Set rails to allow for settlement, camber, and deflection of falsework, as necessary to obtain a finished surface true to the required grade and cross-section. Adjust rails as necessary to correct for unanticipated settlement or deflection that may occur during the finishing operations. If rail supports are located within the area where concrete is being placed, as soon as they are no longer needed, remove them to at least 3 inches (75mm) below the finished surface and fill the void with fresh concrete.

- (b) **Construction Joints.** Build construction joints as specified in Subsection 509.04(d) or as directed. Where the deck is continuous over abutments or piers, place a construction joint at the end of simple spans. Wait at least 24 hours between placement of adjacent deck sections.

After concrete has been placed on both sides of the joint and has hardened, saw-cut the top of the joint 1 inch (25mm) deep and $\frac{1}{4}$ inch (6mm) wide and seal with an approved sealant unless otherwise specified. Use a rapid cure joint sealant as specified in Section 701.08(h) when sealing construction joints on bridges subjected to vibration from traffic.

Refer to Subsections 509.04(e)4 and 5 for requirements covering waterstops and compression joint seals, respectively.

- (c) **Expansion Joints.** Furnish and install the types of expansion devices specified in the contract documents.
1. *Metal Expansion Joints.* Fabricate metal expansion joints, such as, sealed expansion joints and finger type expansion joints, according to Section 506.

Carefully check the expansion devices for line, grade, and crown. Install expansion joint assemblies so that the top surface of the joint matches the plane of the adjacent finished concrete for the entire length of the assembly.

Employ positive methods of placing the assemblies to keep them in correct position during concrete placement. Cut all rigid connections between opposite halves of an expansion joint after initial set of the concrete has occurred to avoid damaging the concrete from joint movement due to thermal changes in the superstructure.

The traffic rail and concrete parapet opening dimension shall have the same opening dimension as the expansion joint.

Before installing the neoprene gland in sealed expansion joints, clean steel surfaces that will contact the neoprene.

2. *Joints Made of Elastomeric Mortar and Rapid Cure Joint Sealant.* Furnish elastomeric mortar and rapid cure joint sealant complying with Subsection 701.08(h). Install these materials as specified in the contract documents.

For new concrete surfaces, form concrete to comply with the shape shown on the plans. Strip forms and clean the concrete surfaces to assure proper bond of the elastomeric mortar. For existing concrete surfaces, saw, flush and clean joints according to Subsections 419.04(a), (b), and (c) of the Standard Specifications and as recommended by the manufacturer. Blast-clean steel surfaces according to SSPC-SP10, Near-White Blast Cleaning. After completing surface preparation, notify the Engineer so that the joint may be inspected and approved, before installing the elastomeric mortar (nosing).

Install the elastomeric mortar when the joint surface temperature is 45°F (70°C) or higher. The application of heat, when recommended by the manufacturer, may be used to improve the curing time of the elastomeric mortar. Allow the mortar to cure at least two hours (four hours for joint surface temperatures below 70°F (21°C)) before loading with traffic.

After the elastomeric mortar has been successfully installed, install the rapid cure joint sealant when the joint surface temperature is 60°F (15°C) or higher. The best time for installing the sealant in expansion joints is when the openings are at a minimum width. Do not install the sealant if the expansion joint opening is less than 3/4 inches (19mm) or more than 2 1/2 inches (63mm); notify the Engineer.

Provide a qualified representative of the elastomeric mortar and sealant manufacturers at the beginning of the work to ensure adequate workmanship and for inspection of the sealing operation.

- (d) **Reinforcing Steel Placement.** Comply with Section 511. Place the ends of transverse reinforcing steel bars 2 inches (50mm) from the edge of the deck or slab. Place the ends of longitudinal reinforcing steel bars, including parapet bars, 1 inch (25mm) from the end of the concrete or expansion device. Use approved wire supports to support the reinforcing steel. Extend longitudinal reinforcing steel bars through construction joints unless otherwise specified in the contract documents.

(e) **Concrete.** Comply with the requirements of Section 509.

1. *Prepour Check.* Before concrete placement begins, make a dry run with the finishing machine to check the following:

- cover on reinforcing steel,
- rail deflection,
- proper deck thickness, and
- operation of all equipment.

Make all necessary corrections before concrete placement has begun.

2. *Placement.* Deposit the concrete ahead of the finishing machine, slightly higher than the finished surface. Keep a slight excess of concrete in front of the cutting edge of the screed at all times. Carry the excess all the way to the edge of the pour or form and waste it.

Place concrete at a rate that completely covers 25 feet (8m) or more per hour, measured longitudinally along the length of the bridge.

During hot weather, place concrete during the cooler times of the day or at night, if necessary, to comply with temperature requirements of Subsection 509.04(b). The Engineer may require placing concrete during the nighttime hours during hot weather. The Engineer will inform the Contractor, in writing, if night placing becomes necessary.

3. *Lighting.* If requested to place concrete during nighttime hours, conform to the requirements of Subsection 509.04(c)3.3.
4. *Finishing.* Immediately after consolidating the concrete, use the finishing machine to transversely strike off the concrete to the proper profile. Use a float to finish the concrete to a smooth, even surface throughout the entire bridge length. Finish transversely unless longitudinal finishing is permitted.

Do not spray water onto the surface of concrete to assist in finishing operations, unless otherwise permitted. If the application of water is permitted, apply a fine mist that does not disturb the surface of the fresh concrete.

While the concrete is still plastic, test the trueness of the concrete surface with a 10-foot (3m) straightedge. Fill depressions with fresh concrete, and cut down high areas. Consolidate, strike off, and refinish the repaired areas. Check the surface across joints to meet all smoothness requirements.

When grooving fresh concrete, use the finned float at such time and in such a manner that the desired texture will be achieved while minimizing displacement of the larger aggregate particles in the fresh concrete. When saw-cut grooving is to be used, floating shall be the last step in finishing. Refer to Subsection 504.04(g) for grooving requirements.

Apply the same final finish to the approach slabs that is applied to the bridge decks or, if overlaid, bridge deck overlays.

If the concrete bridge deck is to receive a concrete overlay, use a machine or float finish. Do not use a broom finish or drag finish.

5. *Fogging and Curing.* Limit moisture loss from fresh concrete by first, fogging and then, curing. Begin fogging immediately after concrete strike-off, and continue until the concrete is protected from moisture loss by curing.

Fog according to the requirements of Subsection 504.03(c). Control evaporation adequately to prevent premature crusting of the surface or an increase in drying cracking. Limit the application of moisture to avoid either disturbing the finish or collecting water in puddles. Do not use water from fogging as an aid to finishing the concrete.

Cure bridge deck and approach slab concrete using both the liquid membrane curing compound method and the water method described in Subsection 509.04(f). Immediately after final finishing, apply liquid membrane curing compound. When the surface has hardened sufficiently that no damage to the finish will result, apply covering material and begin curing in accordance with the water method.

Cure bridge deck and approach slab concrete uninterrupted during the curing period. Do not prematurely remove covering material to form the rail or parapet, unless the exposed area is kept continuously wet.

6. *Removing Forms.* Comply with Subsection 502.04(c).

- (f) **Surface Correction through Grinding.** Test the hardened driving surfaces after curing for trueness using a 10-foot (3m) straightedge or other specified device before final acceptance. Mark and grind areas having high spots of 1/8 inch (3mm) or more, or areas requiring grinding to meet smoothness specifications. Grind after the concrete curing period is completed, and according to Section 425. Discontinue grinding when the out-of-tolerance areas are within specified tolerances. Do not reduce the concrete cover of reinforcing steel to less than 2 inches (50mm). Restore the skid-resistant surface in ground areas using saw-cut grooving.

Remove and replace, at no additional cost, bridge decks and approach slabs which cannot be corrected to specification tolerances.

- (g) **Transverse Grooving.**

1. *Groove Geometry.* Make grooves by finned floating, tining, or saw cutting to the dimensions and tolerances given in Table 504-1. Make the cross-section of grooves rectangular for saw-cut grooves, or approximately rectangular for finned-float grooves. Measure the width tolerance at mid-depth of the groove. Begin grooves within 2 feet (0.6m) of the face of the parapet, guardrail, or curb, and run continuously across the width of the bridge to within 2 feet (0.6m) of the face of the opposite parapet, guardrail, or curb. Do not groove within 6 inches (150mm) of a construction joint. Do not overlap parallel grooving patterns. For curved bridges, make grooves transverse to the cord of the curve within each span. Provide means to accurately measure grooves.

Table 504-1
Groove Dimensions

Groove Dimension	Allowable Size, inches (mm)	
	<u>Finned-Float</u>	<u>Saw-Cut</u>
Width	$\frac{1}{16}$ to $\frac{1}{4}$ (1.5 to 6)	$\frac{1}{8}$ to $\frac{1}{4}$ (3 to 6)
Depth	$\frac{1}{8}$ to $\frac{1}{4}$ (3 to 6)	$\frac{1}{8}$ to $\frac{3}{16}$ (3 to 5)
Spacing (c/c)	$\frac{1}{2}$ to $\frac{3}{4}$ (6 to 19)	$\frac{1}{2}$ to 1 (6 to 12)

**Randomly vary the groove spacing between $\frac{3}{4}$ inch (19mm) to $1\frac{1}{2}$ inch (38mm) for saw-cut grooving for bridges more than 1000 feet (300 m) long.*

2. **Grooving Hardened Concrete.** Provide saw-cut transverse grooving for bridge decks and approach slabs under the following conditions:
 - Saw-cut transverse grooving is specified in the contract documents as a pay item.
 - Transverse grooving must be replaced after grinding.
 - Out-of-tolerance transverse grooving must be corrected.

Begin saw-cut grooving after the concrete curing period is complete and grinding repairs are complete. If significant spalling occurs, discontinue grooving until the cause of the spalling is identified and corrected. If during the course of the grooving work a single blade on any individual multiple blade grooving machine becomes incapable of cutting a groove, the work may continue for the remainder of the work shift before repairing the damaged blade. Repair of the omitted groove will not be required. If more than one blade is damaged or the machine is producing otherwise unacceptable work, discontinue work with the machine in question and repair the unacceptable areas.

3. **Slurry Removal.** While grooving, continuously vacuum the slurry and residue caused by the grooving operation. Prevent the flow of slurry across the bridge deck and lanes open to traffic, or into gutters or other drainage facilities. Immediately after grooving, clean the pavement or bridge deck such that the surface is not slippery from slurry residue. Dispose of slurry in an approved manner.

(h) Load on Decks and Approach Slabs.

1. **Construction Loads.** Light materials and equipment may be carried on bridge decks and approach slabs only after the concrete has been in place at least 24 hours, providing curing is not interfered with and the surface texture is not damaged. Allow the last placed concrete on a span or approach slab to attain a compressive strength of at least 2500 psi (17MPa) before loading it with construction vehicles having a weight between 1000 pounds (450kg) and 4000 pounds (1800kg) and comparable materials and equipment loads. Allow the concrete to attain its full specified strength before placing loads in excess of the above. In addition, for post-tensioned structures, complete the tensioning of a span before loading that span with vehicles weighing more than 4500 pounds (2000kg) and comparable material and equipment loads.

Do not place equipment or other loads which exceed the bridge design load. Do not operate a mixer on concrete bridge decks without approval. Only rubber-tire construction vehicles will be allowed on bridge decks or approach slabs.

2. *Traffic Loads.* Unless otherwise specified in the contract documents, do not permit traffic loads on concrete decks or approach slabs until at least 14 days after the last placement of deck concrete and until all concrete in the structure has attained its specified strength.
- (i) **Rails, Parapets, and Curbs.** For concrete rails, parapets, and curbs, comply with Sections 509 and 511. For cast-in-place superstructures, such as, slab spans, pan girders, and post tensioned spans, do not place railing, parapets, and curbs until the falsework for the span has been released and the span swung.
 1. *Forming.* Comply with Section 502. The slip form method may be permitted for the construction of parapets provided that:
 - the results are equal in all respects to those obtained by the use of fixed forms, and
 - adequate arrangement is provided for curing, finishing, and protecting the concrete.
 2. *Curing.* Cure all rail and parapet concrete according to the methods described in Subsection 509.04(f). Either the forms-in-place method or the water method may be used. Use the water method for exposed surfaces. If forms are removed and the finish applied before completing the specified curing period, resume curing for the balance of the curing period.
 3. *Finish.* Provide a Class 2, rubbed finish for all exposed concrete surfaces of rails and parapets, and sides of curbs as specified in Subsection 509.04(g). Finish the tops of curbs with a wooden float.
 4. *Line and Grade.* Build the line and grade of the parapet or rail as specified in the contract documents. Unless otherwise specified, make parapets vertical. Make handrailing parallel to the curbs.

504.05. METHOD OF MEASUREMENT.

Concrete bridge decks will be measured as specified in Section 509 for Class AA Concrete and Section 511 for Reinforcing Steel. Quantities of concrete and reinforcing steel resulting from larger than planned haunches, will not be measured for payment.

Approach slabs will be measured by the square yard (square meter) of completed approach slab according to the top surface dimensions specified by the contract documents or the Engineer.

Saw-cut grooving will be measured by the square yard (square meter) of surface bounded by the ends of the approach slabs and the edges of the clear roadway. Grinding will not be measured for payment.

Expansion joints shall be measured by the linear foot (meter) along the centerline of the joint (at the top of the joint cross section) from end to end of the joint.

Rapid cure joint sealant will be measured by the linear foot (meter) as shown on the plans. Measurement will be along the centerline of the joint at the surface of the roadway. *Elastomeric mortar* will be measured by the cubic foot (cubic meter) as shown on the plans or as directed by the Engineer. Other joint fillers and joint sealers will not be a separate pay item, but the cost of the same shall be included in the price of other bid items.

Authorized *floodlighting* will be measured for payment by the day. A day is defined as the period of time included in one continuous period of darkness. Each day of floodlighting will include the cost of furnishing, installing, maintaining, and servicing the lights, including the electric current required and any other additional costs incurred for concrete placement at night. Consider floodlighting authorized for the same period the Engineer requires nighttime concrete placement in writing.

Concrete rail, parapet or metal handrail with concrete posts will be measured by the linear foot (meter) from outside to outside of end posts with no deduction for expansion joint gaps. *Metal posts* will be measured by the linear foot (meter) from end to end of railing in place.

Unless otherwise provided, incidental items will be paid for as provided under the following sections:

Metal Drains	506
Reinforcing Steel for Structures	511

504.06. BASIS OF PAYMENT.

The accepted quantities, measured as specified in this Section, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the Plan bid schedule. Payment will be full compensation for the respective work prescribed in this Section. Payment will be made under:

- (A) APPROACH SLAB SQUARE YARD(SQUARE METER)
- (B) SAW-CUT GROOVING SQUARE YARD (SQUARE METER)
- (C) EXPANSION JOINTS LINEAR FOOT (METER)
- (D) FLOODLIGHTING DAY
- (E) CONCRETE RAIL LINEAR FOOT (METER)
- (F) CONCRETE PARAPET LINEAR FOOT (METER)
- (G) HANDRAILING LINEAR FOOT (METER)
- (H) RAPID CURE JOINT SEALANT LINEAR FOOT (METER)
- (I) ELASTOMERIC MORTAR CUBIC FOOT (CUBIC METER)

SECTION 505

REPAIR AND OVERLAY OF CONCRETE BRIDGE DECKS

505.01. DESCRIPTION.

- (a) **Repair.** Repair of bridge decks consists of removing loose, delaminated, spalled, or deteriorated concrete from the existing surface, replacing with new high density concrete, or latex modified concrete and other necessary work as specified in the contract documents. When the bridge deck is to be overlaid, the replacement material for Class A and Class B repair shall be the same as the overlay material.

The Engineer will make a field inspection of all bridge decks and determine the areas of concrete deck to be repaired. These areas will be marked by the Engineer and repaired by the Contractor. The lower limit for Class A and Class B bridge deck repair shall be to suitable